SM315 Assignments

September 3, 2003

1. Due: Wed. Aug. 27

   (a) Derive the heat equation for a rod with insulated lateral surface if the cross-sectional area A depends on position x.

   (b) Consider water in a pipe of uniform cross-section A with a pollutant in it. Let $u(x, t)$ denote the concentration [kg/m^3] of the pollutant. Assume that the mass flux [kg/m^2·s] due to diffusion obeys Fick's law:

   $$\phi_{diff}(x, t) = -k\frac{\partial u}{\partial x}(x, t).$$

   By considering a small element of pipe between x and $x + \Delta x$ show

      i. if the water in the pipe is stationary, show then u obeys the partial differential equation

      $$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}.$$

      ii. if the water in the pipe is flowing to the right with constant velocity c (and there is diffusion also), then u obeys the partial differential equation

      $$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2} - c\frac{\partial u}{\partial x}.$$

   (c) Problem 1.2.9, p. 10.

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2. Due Wed. Sept. 3

    (a) Problem 1.3.2 p. 14.

    (b) Problems 1.4.1 (d),(f),(g), 1.4.3, 1.4.7 (a), p. 18

3. Due Mon Sept. 8

    Problems 2.2.1, 2.2.2 , 2.2.3, 2.2.4 p. 38